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## Response of wheat (*T. aestivum* L.) to rock phosphate, biofertilizer and FYM under North Gujarat condition

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### ABSTRACT

A field experiment was conducted at S.K. Nagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* 2010-11 on loamy sand soil to assess the agronomic feasibility of Udaipur rock phosphate (URP) sources (URP 31% and URP 34%), incubation methods (No incubation, Incubation with farmyard manure, Incubation with phosphate solubilizing bacteria, Incubation with farmyard manure + phosphate solubilizing bacteria) and farmyard manure (zero and ten tonnes ha<sup>-1</sup>) on Wheat (*Triticum aestivum* L.). The agronomic efficacy of the sources of URP 31% and 34% was not found significant in all the aspects. However, effect of incubation methods influenced the productivity and nutrient uptake by wheat crop. Application of farmyard manure @ 10 tonnes ha<sup>-1</sup> also had direct significant effect in improving yield attributes, yields (grain, straw and biological), nutrient content in grain and straw and uptake by wheat crop. Application of P<sub>2</sub>O<sub>5</sub> @ 40 and 60 kg ha<sup>-1</sup> was found to be at par, while both the sources of P (i.e. Diammonium phosphate and Udaipur rock phosphate) were found equally effective. the sources of P (i.e. Diammonium phosphate and Udaipur rock phosphate) were found equally effective.

**Keywords :** FYM, Phosphate solubilizing bacteria, *Triticum aestivum*, Udaipur rock phosphate, Wheat.

### INTRODUCTION

Wheat (*Triticum aestivum* L. emend. Fiori & Paol.) is the world's single most important cereal crop not only in quantitative but in qualitative terms too and considered to be integral component of food security system of several nations and to feed the increasing population production is to be increased. Phosphorus is one of the important major nutrients required by crop and in many soils its availability limits the crop yields due to intensive cropping and adoption of high yielding varieties in irrigated agriculture. The agronomic efficacy of rock phosphate as a direct phosphorus fertilizer along with certain acidulants was evaluated in wheat by Pareek *et al.* (2004) and Soni and Aery (2004). The results indicated that acidulants such as farmyard manure, vegetable waste, saw dust etc. results in enhancement in crop production over the absolute control. Therefore, present investigation was carried out to work out the effect of applied Udaipur rock phosphate sources incubated through various methods in presence and absence of farmyard manure on productivity and nutrient content and uptake by wheat.

### MATERIALS AND METHODS

The field experiment was conducted during the *rabi* (winter) season of 2010-11 at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar. The soil was loamy sand in texture having

available nitrogen 149 and 138 kg ha<sup>-1</sup> from 15 and 30 cm depth (Jackson, 1978 Method) and available phosphorus 29.35 and 31.20 kg ha<sup>-1</sup> from 15 and 30 cm depth (Olsen method, Jackson, 1978). The soil was slightly saline in reaction (pH 7.2 - 7.7). 18 treatments were evaluated, viz. three sources of Udaipur rock phosphate @ 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> (31 and 34%). four incubation methods (No incubation, Incubation with farmyard manure, Incubation with phosphate solubilizing bacteria and Incubation with farmyard manure + phosphate solubilizing bacteria) and two farmyard manure levels (zero and ten tonnes ha<sup>-1</sup>) along with two checks (40 and 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> through diammonium phosphate). Recommended dose of nitrogen (120 kg ha<sup>-1</sup>) was applied to wheat crop through urea.

Before incubation a fix quantity of 300 kg soil of respective field was added to the rock phosphate. The Udaipur rock phosphate (URP) was incubated for 21 days in gunny bags with continuous aeration and wetting before use. These 18 treatment combinations [(2×4×2)+2] were replicated three times in factorial randomized block design. *Bacillus subtilis* var. phosphaticum was used for incubation. A uniform dose of 60 kg N ha<sup>-1</sup>, all the phosphorus sources and farmyard manure were applied at sowing of wheat. Remaining 60 kg N ha<sup>-1</sup> was top-dressed at the time of first irrigation. Wheat was harvested from each experimental plot separately.

The observations were recorded on yield determinates and yield of wheat at harvest. The plant samples were

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collected at harvest and analyzed for nitrogen and phosphorus content in grain and straw. Nitrogen in the samples was estimated as per Jackson (1967) and phosphorus by Jackson (1978). The total nutrient uptake by the crop was worked out by multiplying nutrient content in grain and straw with their respective mass and summing uptake values of grain and straw.

## RESULT AND DISCUSSION

**Udaipur Rock Phosphate Sources :** While assessing the comparative efficacy of URP (31 & 34%) in respect of growth parameters, yield attributes and yields (grain, straw and biological) nutrient content and uptake of wheat, both the URP sources were proved equally effective. The better efficacy of URP sources might be due to absence of carbonate gangue and the acidity generated by organic acidulating materials helps in bringing phosphorus into available forms, the

agronomic efficacy of rock phosphate as a direct fertilizer was also evaluated on wheat by Pareek *et al.*, (2004) and Soni and Aery (2004) and they observed rock phosphate as a better source of phosphorus.

**Incubation Methods :** Incubation of URP with FYM, PSB and FYM+PSB recorded significant improvement in yield attributes, yields (grain, straw and biological), nutrient content and their uptake by wheat crop over no incubation. Incubation of URP with FYM + PSB increased grain, straw and biological yields by 14.24, 11.29 and 12.49 per cent over no incubation. Corresponding increase with FYM incubated URP were to be the tune of 8.77, 6.25 and 7.27 percent respectively, over no incubation. These results might be due to better nutritional environment in plant under incubation of URP with FYM and FYM+PSB treated plots, which have increased the solubility and availability of phosphorus from URP and yield forming components of crop. The results are in close conformity with Shaktawat *et al.* (2004).

**Table 1.** Effect of rock phosphate sources, incubation methods and FYM on dry matter accumulation at tillering, flowering and harvest, effective tillers, no. of grains, 1000 grain weight, grain yield, straw yield and biological yield of wheat

Treatment	Dry matter accumulation (g m <sup>-2</sup> )			Effective tillers (m <sup>-2</sup> )	No. of grains (spike <sup>-1</sup> )	1000 grain weight (g)	Grain yield (q ha <sup>-1</sup> )	Straw yield (q ha <sup>-1</sup> )	Biological yield (q ha <sup>-1</sup> )
	Tillering	Flowering	Harvest						
URP sources (60 kg P <sub>2</sub> O <sub>5</sub> ha <sup>-1</sup> )									
URP (31%)	286.19	663.42	1151.52	375.61	43.26	36.36	44.12	64.60	108.72
URP (34%)	287.24	671.43	1186.56	379.84	44.62	37.68	45.25	65.91	111.17
SEm±	4.97	10.97	25.26	6.15	1.44	1.10	0.96	1.29	1.23
CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Incubation									
No incubation	277.64	615.56	1105.42	351.32	42.16	36.14	41.85	62.27	104.11
Incubation with FYM	290.07	694.23	1216.28	384.75	45.08	37.21	45.52	66.16	111.68
Incubation with PSB	284.53	644.41	1127.92	372.15	43.13	36.62	43.57	63.31	106.87
Incubation with FYM+PSB	294.63	715.50	1226.55	402.67	45.41	38.12	47.81	69.30	117.11
SEm ±	7.03	15.51	35.72	8.69	2.04	1.56	1.36	1.83	1.74
CD 5%	NS	44.57	102.67	24.98	NS	NS	3.91	5.26	5.00
FYM (t ha <sup>-1</sup> )									
0	278.31	651.23	1112.57	368.75	41.67	35.22	42.99	63.27	106.26
10	295.12	683.61	1225.51	386.70	46.21	38.82	46.38	67.24	113.63
SEm±	4.97	10.97	25.26	6.14	1.44	1.10	0.96	1.29	1.23
CD 5%	14.28	31.52	72.60	17.66	4.14	3.17	2.77	3.72	3.54
Check (P <sub>2</sub> O <sub>5</sub> kg ha <sup>-1</sup> )									
40	290.34	678.15	1214.67	384.26	44.19	36.11	43.24	62.42	105.67
60	295.68	689.43	1230.46	395.92	45.94	38.65	47.36	68.49	115.86
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	S
Check vs. Rest treatments									
Check (DAP)	293.01	683.79	1222.56	390.09	45.07	37.38	45.30	65.46	110.76
Rest treatments	286.72	667.42	1169.04	377.72	43.94	37.02	44.69	65.26	109.94
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	8.47	8.03	10.53	7.94	16.03	14.58	10.54	9.70	5.58

NS : Non-Significant S : Significant

**Farmyard manure (FYM) :** The growth parameters viz. Plant height and dry matter accumulation at tillering, heading and at harvest and the yield attributes influenced due to farmyard manure application to wheat, thereby grain, straw and biological yields also increased significantly by 7.89, 6.27 and 6.94 per cent over no FYM. Marked increase of nutrient (N and P) content in plant parts (grain and straw) at harvest along with their total uptake also registered under effect of farmyard manure, the total uptake both in grain and straw along with total accumulation of N and P by 9.86 and 14.37 per cent over no FYM. In general, this is just due to improved nutritional status of both N and P in plant parts under farmyard manure application primarily seems to be on account of enrichment of these nutrients in soil. Secondly, it can be attributed to their efficient extraction per translocation in the plant system due to enhanced activities of roots on account of pivotal role of farmyard manure on maintenance of better physico-chemical and biological properties of soil. The results

are in close conformity with findings of Singh *et al.* (1998) and Chaplot (2000).

**Effect of phosphorus levels :** The results revealed that increased application of phosphorus from 40 and 60 kg  $P_2O_5$  ha<sup>-1</sup> through diammonium phosphate proved similar effect on growth parameters, yield attributes, yields (grain and straw), nutrient content and it's uptake. This might be due to medium phosphorus status of the experimental soil and higher extraction capacity of wheat plants to utilize the native phosphorus present in soil.

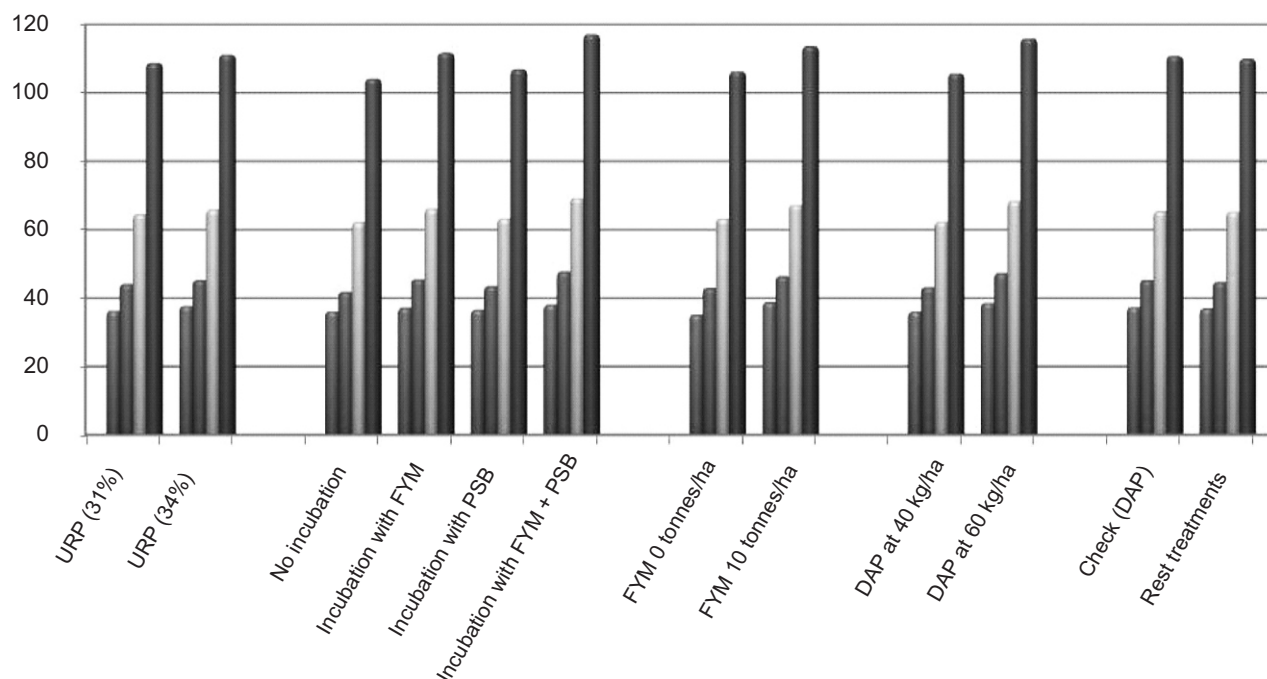
**Check vs. Rest treatments :** Effect of URP to wheat crop found equally effective to that of effect of diammonium phosphate (check) in influencing growth parameters, yield attributes, production, nutrient content and uptake by wheat. The equal performance of Udaipur rock phosphate to that of Check (DAP) was probably due to solubilization of phosphorus from Udaipur rock phosphate in presence of

**Table 2.** Effect of rock phosphate sources, incubation methods and FYM on nitrogen and phosphorus content and uptake of grain and straw of wheat

Treatment	N Content (%)		P Content (%)		N uptake (kg ha <sup>-1</sup> )			P uptake by (kg ha <sup>-1</sup> )		
	Grain	Straw	Grain	Straw	Grain	Straw	Total uptake by crop	Grain	Straw	Total uptake by crop
<b>URP sources (60 kg <math>P_2O_5</math> ha<sup>-1</sup>)</b>										
URP (31%)	1.734	0.427	0.495	0.143	71.65	27.44	99.09	22.04	9.48	31.51
URP (34%)	1.744	0.428	0.500	0.145	73.03	28.80	101.83	23.07	9.57	32.65
SEm±	0.02	0.01	0.01	0.01	2.16	0.67	2.17	0.55	0.20	0.70
CD 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Incubation</b>										
No incubation	1.714	0.424	0.461	0.139	66.92	25.22	92.13	19.98	8.72	28.70
Incubation with FYM	1.749	0.428	0.510	0.146	75.45	29.15	104.60	23.74	10.11	33.85
Incubation with PSB	1.733	0.426	0.500	0.144	68.30	26.76	95.06	21.95	9.13	31.09
Incubation with FYM+PSB	1.760	0.432	0.519	0.147	78.68	31.35	110.04	24.54	10.14	34.68
SEm±	0.03	0.01	0.01	0.01	3.05	0.95	3.07	0.78	0.28	0.99
CI) 5%	NS	NS	0.04	NS	8.76	2.72	8.81	2.24	0.79	2.84
<b>FYM (t ha<sup>-1</sup>)</b>										
0	1.732	0.426	0.495	0.136	69.23	26.50	95.74	20.95	8.98	29.93
10	1.746	0.429	0.500	0.152	75.44	29.74	105.18	24.16	10.07	34.23
SEm±	0.02	0.01	0.01	0.01	2.16	0.67	2.17	0.55	0.20	0.70
CD 5%	NS	NS	NS	0.01	6.19	1.92	6.23	1.58	0.56	2.01
<b>Check (<math>P_2O_5</math> kg ha<sup>-1</sup>)</b>										
40	1.723	0.422	0.486	0.139	71.49	27.25	98.75	21.24	9.35	30.59
60	1.745	0.429	0.527	0.154	76.83	29.43	106.25	24.17	10.42	34.59
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Check vs. Rest treatments</b>										
Check (DAP)	1.734	0.426	0.507	0.147	74.16	28.34	102.50	22.70	9.88	32.59
Rest treatments	1.739	0.428	0.497	0.144	72.34	28.12	100.46	22.55	9.52	32.08
'F' test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	6.01	5.54	9.93	14.68	14.55	11.64	10.55	11.97	10.02	10.64

NS : Non-Significant





**Fig. 1.** Effect of rock phosphate sources, incubation methods and FYM on 1000 grain weight, grain yield, straw yield and biological yield of wheat

phosphate solubilizing bacteria and farmyard manure. Similar findings were reported by Shaktawat *et al.* (2001) and Rajput *et al.* (2007).

Based on the results emanated from the present investigation, it is inferred that application of 60 kg  $P_2O_5$  ha<sup>-1</sup> through Udaipur rock phosphate (34%) incubated with Farmyard manure + Phosphate solubilizing bacteria along with addition of 10 tonnes Farmyard manure ha<sup>-1</sup> and recommended dose of nitrogen (120 kg ha<sup>-1</sup>) to wheat crop is most appropriate nutrient management system for getting higher grain yield.

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